TEXAS TECH UNIVERSITY
Natural Science Research Laboratory

Occasional Papers

Museum of Texas Tech University Number 272 11 March 2008

Inventory of the Mammalian Species at Vicksburg National Military Park, Vicksburg, Mississippi

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Abstract

A year-long mammal survey at Vicksburg National Military Park (VICK), Vicksburg, Mississippi, was conducted during 2005. Presence was documented using photographs, sign, and voucher collections, incorporating multiple capture and monitoring techniques such as live-trapping, pitfall traps, remote cameras, mist nets, and ANABAT II detectors. A total of 1,011 detections of 37 mammal species was recorded in 9,871 trap nights, 16,392 camera hours, and 352 mist-netting hours. Overall capture indices were 1.7 per 100 trap nights (TN) for small mammals, 33.5 per 100 TN for meso- and large mammals, and 37.0 per 100 TN for bats. Species accumulation curves and predicted species richness estimates indicate that trapping effort was sufficient for a complete inventory. However, nine species (*Ochrotomys nuttalli*, *Oryzomys palustris*, *Reithrodontomys fulvescens*, *Ondatra zibethica*, *Rattus rattus*, *Rattus norvegicus*, *Neovison vison*, *Lontra canadensis*, *Spilogale putorius*) that have distributions overlapping the study area were not detected. These mammals should be regarded as potential but unconfirmed species in the park.

Key words: bats, inventory, large mammals, mesomammals, Mississippi, small mammals, species accumulation curve, species richness, Vicksburg National Military Park

Introduction

Urbanization is a continuing trend that often results in a decrease of wildlife habitat and may eventually lead to wildlife extirpations (Kurta and Teramino 1992; Rosenblatt et al. 1999). Urbanization transforms wild lands to better meet the needs of humans (Adams et al. 2006). The term "synurbization" has been coined by ecologists to describe the adjustments made by wild animals to specific conditions of the urban environment (Luniak 2004). Small urban parks are frequently assumed to be unsuitable in maintaining high levels of biodiversity due to possible exclusion of species that have large home range requirements, areas that contain small populations, and an abundance of generalist species (Dickman 1987). However, rapid depletion of natural resources in North America make National Parks a significant refuge for once-widespread species and ecosystems (National Park Service 2004).

To date, biological inventories at Vicksburg National Military Park (VICK), Mississippi, have focused on birds (Twedt and Hunt 2001; Somershoe et al. 2004; National Audubon Society 2006), vascular plants (Walker 1997), fishes (Dibble and Smiley 1999; Dibble 2003), and herpetofauna (Keiser 2002) but not mammalian species. Therefore, this study was conducted to provide information regarding the park's mammalian biodiversity that could be used as a basis for management decisions regarding urban encroachment, presence of threatened and/or endangered species, and prevalence and impacts of exotic species. The objectives were to (1) document through existing, verifiable data and targeted field investigations, the presence of all mammal species that occur in VICK, and (2) describe the distribution and relative abundance of each species.

STUDY AREA

Vicksburg National Military Park, located in Warren County, Mississippi, and Madison Parish, Louisiana, was included within the Gulf Coast Inventory and Monitoring Network created by the NPS Natural Resource Challenge Initiative. The park was established in 1899 to commemorate the Battle of Vicksburg during the American Civil War and consists of approximately 728 ha, including four satellite locations in the city of Vicksburg, Mississippi (Louisiana Circle, Navy Circle, South Fort, Pemberton's Headquarters) and one in Delta, Louisiana (Grant's Canal). Because each satellite location is less than 0.40 ha, most sampling was conducted in the main portion of VICK located in northeastern Vicksburg, adjacent to Clay Street. This portion of VICK is crescent shaped and fragmented by a 26-km tour road. Most of the park property lies on steep bluffs and includes deep ravines. The city of Vicksburg completely surrounds the Warren County portion of VICK with residential houses and businesses abundant along park boundaries.

Vicksburg National Military Park is within the East Gulf Coastal Plain. The climate is subtropical (Stewart 2003) and mean annual temperature ranges from 12°C to 25.2°C. Mean annual precipitation is 147.1 cm (NOAA 2006). Forested sections were dominated by southern red oak (*Quercus falcata*) and white oak (*Q. alba*) with southern sugar maple (*Acer barbatum*), basswood (*Tilia americana*), black oak (*Q. velutina*), and northern red oak (*Q. rubra*). Understory vegetation consisted mainly of American hornbeam (*Carpinus caroliniana*), dogwood (*Cornus florida*), redbud (*Cercis canadensis*), pawpaw (*Asimina triloba*), and sassafrass (*Sassafras albidum*) (Walker 1997). Two streams, Mint Springs and Glass Bayou, flow through VICK and drain into the Yazoo River Diversion Canal, which then empties into the Mississippi River. The park includes an approximately 0.8-km stretch of land located adjacent to the Yazoo River, which is subject to periodic flooding.

METHODS

Prior to beginning field inventories, mammalian species accounts for Warren County, Mississippi, and Madison Parish, Louisiana, were examined. A search of the museum collection housed at the Mississippi Museum of Natural Science (Jackson, Mississippi) was conducted to locate park-specific Warren County voucher specimens and to verify species identification of curated specimens. The Smithsonian National Museum of Natural History and the Louisiana State University Museum of Natural Science provided voucher information for mammals located within Warren County, Mississippi, and Madison Parish, Louisiana. All voucher specimens from this survey have been deposited in the Mississippi Museum of Natural Science. All sampling was conducted with permits from the State of Mississippi and the National Park Service and conformed to the Institutional Animal Care and Use Guidelines of the University of Georgia (AUP Permit No. A2005-10008-0).

Small Mammals.—Small mammals were surveyed during two separate periods in 2005 (January-April and July-November) using line transects in a stratified design for four different habitat types including riparian, grassland, upland, and edge (within 50 m of grassland/upland ecotone). Transects of at least 30 trap stations (10 m x 10 m) were set for four consecutive nights. For most transects, each station consisted of a Sherman live trap and a Victor snap trap baited with peanut butter and oats set approximately 0.3 m apart. Five pitfall traps were placed at every fifth station using deli cups (8 cm in depth and upper diameter). In addition, one pitfall trap array with drift fence arranged in a "T" configuration was placed in each representative habitat. Drift fences consisted of silt fencing 61 cm high, 100 m long, and supported by wooden stakes. Fourteen pitfall traps per drift fence were installed using 2 #10 coffee cans taped together. For captured individuals, standard museum measurements were taken, gender, mass (g), and reproductive condition (pregnant, lactating, scrotal) were assessed, and most individuals were identified to species. To assess *Glaucomys volans* occurrence, Sherman live traps were mounted 2 m high and positioned vertically along tree boles (S. Loeb, pers. comm. 2005) in bottomland hardwood forest, upland hardwood forest, and upland hardwood edges. Tomahawk traps (# 102, 40.6 x 12.7 x 12.7 cm; Tomahawk, Wisconsin) were used to opportunistically target *Tamias striatus*, *Neotoma floridana*, and *Sciurus niger*. Because morphology of *Peromyscus leucopus* and *Peromyscus gossypinus* is extremely similar, Polymerase Chain Reaction (PCR) analyses using tail clips were conducted to distinguish between these species (Linehan 2007).

Meso- and Large Mammals.—Throughout the year, non-randomly selected survey sites were sampled for meso- and large mammals to focus most trapping effort in riparian habitats and edges and thus maximize capture success. Mesomammals, such as *Procyon lotor* and *Didelphis virginiana*, were trapped using Tomahawk traps (#108, 81.3 x 25.4 x 30.5 cm). Coil spring foothold traps (#3) were used to target *Canis latrans* and *Lynx rufus*. This capture method was only employed for 18 nights due to conflict with park visitors. Bait stations with remote cameras (Leaf River; Taylorsville, Mississippi) and nocturnal spotlight surveys were used to document both mesomammals and large mammals, such as *Urocyon cinereoargenteus*, *Vulpes vulpes*, and *Odocoileus virginianus*. Mammals not easily captured through conventional trapping methods were documented opportunistically. Stream and river surveys were used to document semi-aquatic species, such as *Castor canadensis* and *Myocastor coypus*. Other species, such as *Sylvilagus floridanus*, were recorded only by visual observations. Road-killed animals were recorded as encountered but collected only if the specimen was in suitable condition to obtain voucher material.

Bats.—Mist nets (6-18 m wide, 2.4 m high) were placed over streams, small ponds, and flight corridors to sample bats during May-August. Mass (g), forearm length (mm), gender, age (Anthony 1988), and reproductive condition (Racey 1988) of captured bats were recorded. Captured *Nycticeius humeralis* ($n = 7$) had 0.5 g radiotransmitters (Advanced Telemetry Systems; Isanti, Minnesota) attached to the inter-scapular region using Skin Bond (Pfizer Hospital Products Group Inc.; Largo, Florida). A R-2000 (Advanced Telemetry Systems; Isanti, Minnesota) receiver and a 4-element Yagi antenna were used to track bats to day-roosting structures for approximately 10 days throughout the life of the transmitter. Bridges, monuments, and old buildings were surveyed for possible bat roosting locations. Data collected from two ponds located < 100 m outside park boundaries were included as bats captured at these locations likely foraged and roosted inside the park. Mist net hours were calculated using number of hours mist nets were in operation multiplied by number of nets open. Capture indices for bats were estimated using number of bats captured divided by the number of net hours.

Throughout the bat sampling period, several ANABAT II (Titley Electronics; Ballina, Australia) units were placed in areas thought to have high concentrations of bats, such as stream banks and forest corridors, to survey for additional species of bats and to locate possible productive mist-netting locations. Calls were downloaded and analyzed using ANALOOK Software (Version 4.8p; Titley Electronics; Ballina, Australia). The calls of released bats were recorded to develop a call library that was used to aid in qualitatively identifying recorded calls.

All captured species were documented using photographs, and relevant sign (e.g., tracks, scat, and

burrows) were opportunistically identified and photographed. Voucher specimens were prepared if field identification was uncertain or if the capture was the first for VICK. To satisfy NPS goals and requirements, abundance of each species was categorized based on the number of captures and observations using the following scale: rare = 1-5, uncommon = 6-10, fairly common = 11-20, common = 21-50, abundant = 51+. Species accumulation curves were generated for small mammals, meso- and large mammals, and bats and used in comparison with the projected species richness estimates derived from the program SPECRICH (Hines 1996) to quantitatively estimate inventory completeness. Hall (1981) was used for subspecific designations.

RESULTS

A total of 1,011 mammal observations was recorded through capture or observation, representing eight orders, 17 families, and 37 mammal species (Table 1). Thirteen small mammal species were captured with *Peromyscus* sp. (n = 45), *Sigmodon hispidus* (n = 27), *S. niger* (n = 11), and *P. gossypinus* (n = 11) captured most frequently. Ten meso- and large mammal species were documented with *P. lotor* (n = 82), *D. virginiana* (n = 81), and *O. virginianus* (n = 52) captured or observed most often. Seven bat species were captured using 352 mist net hours in riparian areas (181 hours), forest corridors (68 hours) and over roads (103 hours). *Nycticeius humeralis* (n = 40, 42.1%), *Eptesicus fuscus* (n = 27, 28.4%), and *Lasiurus borealis* (n = 18, 19%) were captured most often. *Tadarida brasilensis* was documented using acoustic survey methods only.

Capture success was greatest in riparian areas (2.34%) and edges (1.71%) and lowest in upland sites (1.18%) and grasslands (0.67%). Overall capture success of meso- and large mammals was high (30%) compared to small mammals, while riparian areas (42.4%), roads (30.8%), and urban areas (25.6%) had the highest capture success. Remote cameras (38.9%), foothold traps (38.9%), and large sized Tomahawk traps (16.0%) had the greatest capture success. Overall bat capture success also was relatively high (26.4%), with most species captured over streams or ponds (32.6%), followed by forest corridors (22.1%), and roadways (20.4%). Riparian areas were most productive for capturing highest number of individuals for most bat species. A notable exception was *E. fuscus*, which was captured most frequently over roads (15.5%) and forest corridors (14.7%).

A species accumulation curve reflecting predicted species richness for small mammals displayed an asymptote at 15 species (SE = 2, CI = 13-17). Thirteen small mammal species were documented, which falls within the confidence interval of the interpolated estimate. A meso- and large mammal species accumulation curve showed an asymptote at 12 species (SE = 2, CI = 10-14) for estimated species richness. Ten meso- and large mammal species were recorded, which falls within the confidence interval for the predicted estimate. Predicted species richness for bats was estimated at 9 species (SE = 2, CI = 7-11). Seven bat species were documented during this inventory, falling within the estimated prediction. Documentation of all species and specimens examined is given in the Appendix.

DISCUSSION

This study documented 37 of 46 potential mammal species, or 80% of expected occurrences. This includes 14 small mammal species with *Peromyscus* sp. (most likely *P. leucopus* or *P. gossypinus*) and *S. hispidus* most frequently captured while *S. niger* and *T. striatus* were the most commonly observed. Trapping effort for small mammals appeared to be sufficient based upon predicted species richness estimates. Apparent absence of some small mammal species was probably an artifact of low capture rates for pitfall traps (0.5%), Victor snap traps (2.1%), Sherman live traps set on the ground (2.3%) and in trees (0.3%), remote cameras (1.9%), and small sized Tomahawk traps (3.9%). Capture rates for some traps may be low due

Table 1.—Summary of mammals documented at Vicksburg National Military Park, Vicksburg, Mississippi, in 2005. Abundance category estimates were based on the following scale: rare = 1-5, uncommon = 6-10, fairly common = 11-20, common = 21-50, abundant = 51+.

Scientific Name	# Captured	# Observed	Abundance Category
Didelphis virginiana	81	11	Abundant
Sorex longirostris	1	0	Rare
Blarina carolinensis	8	6	Fairly Common
Cryptotis parva	1	0	Rare
*Scalopus aquaticus**	0	7	Common
Lasiurus borealis	18	0	Fairly Common
Lasiurus cinereus	1	0	Rare
Lasiurus seminolus	1	0	Rare
Pipistrellus subflavus	6	0	Uncommon
Eptesicus fuscus	27	176	Abundant
Nycticeius humeralis	40	0	Common
Tadarida brasiliensis	0	3	Rare
Dasypus novemcinctus	4	10	Fairly Common
*Sylvilagus aquaticus**	0	0	Uncommon
*Sylvilagus floridanus**	0	7	Fairly Common
Tamias striatus	5	21	Common
*Sciurus niger**	11	29	Abundant
*Glaucomys volans**	5	1	Common
Castor canadensis	0	3	Rare
Reithrodontomys humulis	3	0	Rare
Peromyscus gossypinus	11	0	Fairly Common
*Peromyscus leucopus**	7	0	Fairly Common
Sigmodon hispidus	27	1	Common
Neotoma floridana	8	0	Uncommon
Mus musculus	10	1	Fairly Common
Microtus pinetorum	3	1	Rare
Myocastor coypus	0	1	Rare
Canis lupus	50	13	Abundant
Canis latrans	0	3	Rare
Vulpes vulpes	12	8	Fairly Common
Urocyon cinereoargenteus	20	1	Common
Procyon lotor	82	9	Abundant
Mustela frenata	0	1	Rare
Mephitis mephitis	0	2	Rare
Felis catus	1	31	Common
Lynx rufus	7	3	Uncommon
Odocoileus virginianus	52	110	Abundant

*Additional visual and sign observations indicate that abundance estimates may be higher than what the number of captures and recorded observations would indicate.

to the high level of trap disturbance (presumably from mesocarnivores, such as *P. lotor* and *D. virginiana*) for Sherman live traps set on the ground (24%), in trees (8%), Victor snap traps (56%), and small-sized Tomahawk traps (44%). These opportunistic feeders were frequently observed near sampling locations and were often trapped and moved to mediate trap disturbance. Capture indices for small mammals were greatest in riparian areas and lowest in grasslands. The lack of capture success in grasslands may have resulted from regular grass mowing maintenance that prevented establishment of populations.

Vicksburg National Military Park's urban setting influences the species that may occur. Sixteen meso- and large mammal species were documented with sufficient trapping effort based upon species richness estimates. *P. lotor* and *D. virginiana* were captured most frequently and *O. virginianus* and *F. catus* were most commonly observed. Capture indices were especially high in riparian areas, on roads, and in urban areas. Human dominated areas tend to support tolerant species that are capable of adapting to a broad range of habitat conditions and food sources (Wilson 1992).

Six bat species were captured using mist net trapping and one additional species was recorded through acoustic sampling. In comparison to small mammals, capture success was high for bats in all sampled areas including riparian areas, forest corridors, and roads. Projected species richness estimates revealed that this group was satisfactorily sampled. *E. fuscus* and *N. humeralis* were trapped most frequently, which might reflect the ability of these two species to adapt to an increasingly developed landscape. *E. fuscus* were regularly observed roosting under bridges, inside the Illinois Monument, and in an administration building. Radiotelemetry revealed that four out of seven radio tagged *N. humeralis* were roosting in utility poles. The remaining three bats roosted in tree species such as box elder (*Acer negundo*) and American sycamore (*Platanus occidentalis*). The propensity for this species to roost in man made structures might suggest that tree roosts were limiting for this species but further research is necessary for confirmation.

Myotis austroriparius, *L. intermedius*, *Corynorhinus rafinesquii*, *S. carolinensis*, and *Ursus americanus* were undetected and presumed absent due to limited habitat availability. For most of the remaining undetected species (*O. nuttalli*, *O. palustris*, *R. fulvescens*, *O. zibethica*, *R. rattus*, *R. norvegicus*, *N. vison*, *L. canadensis*, *S. putorius*), this inventory was inconclusive and therefore these mammals should be regarded as potential occurrences. Low numbers of *M. musculus* detections and absence of two other commensal species (*R. rattus* and *R. norvegicus*) were surprising considering the close proximity of urban areas.

Alteration of landscapes through urbanization can have profound affects on distribution and abundance of wildlife populations. Adaptable species can be very successful and have populations that may become overabundant, causing property damage and threatening human health and safety (DeStefano and DeGraaf 2003). High density urban wildlife populations may result from increased availability of resources such as food, refugia, or den sites (Riley et al. 1998; Prange et al. 2004).

A recent survey of urban species of most concern ranked raccoons as the species with the greatest magnitude of damage (Adams et al. 2006). Abundant *P. lotor* populations at VICK may require management if the population continues to increase. Dense *P. lotor* populations are more susceptible to epizootics of contact diseases such as rabies and canine distemper (Riley et al. 1998). Population growth for *P. lotor* may result from supplemental food and an absence of mortality factors common in rural areas (Riley et al. 1998; Prange et al. 2004). However, vehicle-related mortality factors and disease transmission may be greater in an urbanized area such as VICK (Prange et al. 2004). Direct urban management of *P. lotor* numbers likely will require continuous control measures, because populations are capable of quickly repopulating an area after the resident population has been reduced. The reduction of anthropogenic food sources may be the most effective control measure (Prange et al. 2004).

An abundance of free-roaming domestic pets in urban areas have been found to constitute ecological and potential public health problems (Liberg 1984; Butler et al. 2003; Lepczyk et al. 2003; Woods et al. 2003). *Felis catus* populations can potentially have a negative ecological impact on wildlife communities in VICK. Predation can play an important role in bird and small mammal population fluctuations (Woods et

al. 2003). Lepczyk et al. (2003) found that on average, a single cat predated between 0.7 and 1.4 birds/week. The Mississippi flyway passes through VICK and over 185 species have been documented (Cooper et al. 2004). Species of high conservation priority, such as the white-eyed vireo (*Vireo griseus*), worm-eating warbler (*Helmitheros vermivorus*), hooded warbler (*Wilsonia citrina*), *Swainson's warbler* (*Limnothlypis swainsonii*), and Kentucky warbler (*Oporornis formosus*), may be at risk if cat populations continue to grow unchecked. In Sweden, cat predation corresponded to 4% of annual reduction of wild rabbits (*Oryctolagus cuniculus*) and approximately 20% of annual reduction of field voles (*Microtus agrestis*) and wood mice (*Apodemus silvaticus*) (Liberg 1984). The abundant *C. lupus* population at VICK may also require some type of management control due to the possible threat to humans and surrounding wildlife. This species is a known reservoir for rabies, canine distemper, and parvovirus (Butler et al. 2003), which is transmittable to humans and/or wildlife living in close proximity. Lethal control measures for domestic cat and dog populations may not be understood and tolerated by the general public (Ash and Adams 2003). Alternate population control methods such as trap-test-vaccinate-alter-return may be more acceptable to stakeholders (Ash and Adams 2003). Public education and leash law enforcement may help to keep domestic pet populations in check (Feldman 1974).

Odocoileus virginianus has adapted quite well to VICK's semi-urban environment. Expanding urban sprawl has created excellent deer habitat with an abundance of food and protection from hunters and nonhuman predators (DeNicola et al. 2000). *O. virginianus* impact on natural ecosystems due to overbrowsing reduces plant cover and diversity and deer can degrade forests where persistent browsing can lead to climax species of plants replaced by midlevel and introduced species (Stromayer and Warren 1997; Waller and Alverson 1997; DeNicola et al. 2000; Cote et al. 2004). Overabundant populations may also contribute to transmission of several animal and human diseases, such as Lyme disease and bovine tuberculosis (Schmitt et al. 1997; DeNicola et al. 2000; Cote et al. 2004) and significant economic losses associated with crop reduction and vehicle collisions (DeNicola et al. 2000). In addition, overabundant deer populations can negatively impact suburban environments due to deer browsing on landscape and garden plants. Browse lines were evident in some forested areas of VICK and evaluation of current densities may be needed to develop appropriate management strategies if populations continue to increase to the point of requiring nuisance control.

Human-wildlife problems are socially defined and vary among different user groups (Decker and Gavin 1987). An animal is considered a nuisance when its population grows beyond cultural carrying capacity (Carpenter et al. 2000). The merging of human ecology and wildlife ecology with conservation of natural resources is critical to conservation success in human-dominated landscapes including small urban parks. Understanding public attitudes and perceptions, promoting wildlife education, and initiating sensible methods of control when necessary is key (DeStefano and DeGraaf 2003).

ACKNOWLEDGMENTS

Funding was provided by the National Park Service and the Daniel B. Warnell School of Forestry and Natural Resources at the University of Georgia. We thank Michael Bender, Brent Howze, and Alison McCartney for field assistance. The support of Kurt Foote and all the staff at Vicksburg National Military Park was invaluable and greatly appreciated.

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APPENDIX

List of mammal species examined (museum records) or collected at Vicksburg National Military Park, Vicksburg, Mississippi, 2005. All voucher specimens from this survey have been deposited in the Mississippi Museum of Natural Science.

Virginia Opossum, *Didelphis virginiana virginiana* Kerr 1792

Specimen examined (1).—USA: Mississippi; Warren County, Ranger Station, UTM 15-702743N-3582008E, 1 (VICK 5271). *Additional records* (58).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703115N-3581925E, 1; Mint Springs, UTM 15-700722N-3583781E, 1; Needmorbottom, UTM 15-701560N-3584139E, 1; Boy Scout Trail S Louisiana Monument, UTM 15-702661N-3581514E, 3; Mint Springs, UTM 15-700812N-3583804E, 16; Boy Scout Area, UTM 15-702635N-3584467E, 1; Boy Scout Trail N Graveyard Rd., UTM 15-702504N-3583608E, 1; Glass Bayou off Modern Jackson Rd., UTM 15-703126N-3582694E, 1; Boy Scout Trail at Grant Ave. and Union Ave. intersection, UTM 15-703311N-3583971E, 12; National Cemetery, UTM 15-700343N-3583952E, 2; Yazoo River Watershed, UTM 15-700075N-3583600E, 1; Glass Bayou at Modern Jackson Rd., UTM 15-702785N-3582580E, 4; Boy Scout Trail S Louisiana Monument, UTM 15-702556N-3581377E, 1; Sherman Circle, UTM 15-703428N-3584300E, 11; E Graveyard Rd., UTM 15-702952N-3583768E, 1; Union Ave. 400 m W Grant Ave., UTM 15-701366N-3584374E, 1.

Southeastern Shrew, *Sorex longirostris longirostris* Bachman 1837

Specimen examined (1).—USA: Mississippi; Warren County, Boy Scout Area, UTM 15-702339N-3584380E, 1 (VICK 5274).

Southern Short-tailed Shrew, *Blarina carolinensis minima* (Bachman 1837)

Specimens examined (10).—USA: Mississippi; Warren County, South Loop, UTM 15-701633N-3579679E, 1 (VICK 5277); South Loop, UTM 15-701139N-3579400E, 1 (VICK 5278); Fort Garrott, UTM 15-701281N-3579838E, 2 (VICK 5279, VICK 5281); South Loop, UTM 15-701728N-3579943E, 1 (VICK 5282); Boy Scout Trail between Tour Stop 4 and 5, UTM 15-703141N-3583414E, 1 (VICK 5302); 200 m N of Pemberton Ave., UTM 15-703099N-3581913E, 1 (VICK 5304); SE Boy Scout Meeting Area, UTM 15-702776N-3584324E, 1 (VICK 5307); Old Hwy 27 100 m S Park Entrance, UTM 15-702307N-3580356E, 1 (VICK 5325); South Fort, UTM 15-697789N-3577411E, 1 (VICK 5333).

North American Least Shrew, *Cryptotis parva parva* (Say 1823)

Specimen examined (1).—USA: Mississippi; Warren County, Yazoo River Watershed, UTM 15-700153N-3583624E, 1 (VICK 5332).

Eastern Mole, *Scalopus aquaticus howelli* Jackson 1914

Specimens examined (2).—USA: Mississippi; Warren County, Ranger's Quarters, UTM 15-700593N-3583989E, 1 (VICK 5280); Trail to Waterfall S National Cemetery, UTM 15-700400N-3583701E, 1 (VICK 5283). *Additional records* (2).—USA: Mississippi; Warren County, 30 m N Jackson Rd. Bridge on Union Ave., UTM-15-703174N-3582810E, 1; National Cemetery, UTM-15-700407N-3583998E, 1.

Eastern Red Bat, *Lasiurus borealis borealis* (Müller 1776)

Specimen examined (1).—USA: Mississippi; Warren County, Confluence of Mint Springs and Mint Springs Tributary, UTM 15-701468N-3584139E, 1 (VICK 5291). *Additional records* (3).—USA: Mississippi; Warren County, Illinois

APPENDIX (CONT.)

Monument, UTM-15-703098N-3582356E, 1; Confluence of Mint Springs and Mint Springs Tributary, UTM 15-701468N-3584139E, 1; Mud Stuck Pond, UTM 15-702826N-3581021E, 1.

Hoary Bat, *Lasiurus cinereus cinereus* (Beauvois 1796)

Specimen examined (1).—USA: Mississippi; Warren County, Confluence of Mint Springs and Mint Springs Tributary, UTM 15-701468 E-3584139 N, 1 (VICK 5292).

Eastern Pipistrelle, *Pipistrellus subflavus subflavus* (F. Cuvier 1832)

Specimen examined (1).—USA: Mississippi; Warren County, Mint Springs, UTM 15-700493N-3583721E, (VICK 5293). *Additional records* (5).—USA: Mississippi; Warren County, SE Missouri Monument, UTM 15-702844N-3583140E, 1; Mint Springs, UTM 15-700698N-3583780E, 2; Mint Springs, UTM 15-700493N-3583721E, 2.

Big Brown Bat, *Eptesicus fuscus fuscus* (Beauvois 1796)

Specimen examined (1).—USA: Mississippi; Warren County, Illinois Monument, UTM 15-703098N-3582356E, 1 (VICK 5294). *Additional records* (4).—USA: Mississippi; Warren County, Illinois Monument, UTM 15-703098N-3582356E, 3; 30 m N Jackson Rd. Bridge on Union Ave., UTM 15-703174N-3582810E, 1; Old Superintendent's Quarters, UTM 15-702812N-3582051E, 2.

Evening Bat, *Nycticeius humeralis humeralis* (Rafinesque 1818)

Specimen examined (1).—USA: Mississippi; Warren County, 30 m N Jackson Rd. Bridge on Union Ave., UTM 15-702844N-3583140E, 1 (VICK 5289). *Additional records* (5).—USA: Mississippi; Warren County, 30 m N Jackson Rd. Bridge on Union Ave., UTM 15-702844N-3583140E, 1; Confluence of Mint Springs and Mint Springs Tributary, UTM 15-701468N-3584139E, 1; Mint Springs, UTM 15-700698N-3583780E, 3.

Nine-banded Armadillo, *Dasypus novemcinctus mexicanus* Peters 1864

Specimen examined (1).—USA: Mississippi; Warren County, Boy Scout Area entrance, UTM 15-702157N-3584008E, 1 (VICK 5317). *Additional records* (7).—USA: Mississippi; Warren County, Boy Scout Trail S Louisiana Monument, UTM 15-702600N-3581239E, 4; Fort Hill, UTM 15-700343N-3583311E, 1; 200 m N Illinois Monument on Union Ave., UTM 15-703377N-3582360E, 1; Maintenance Area, UTM 15-702191N-3580797E, 1.

Swamp Rabbit, *Sylvilagus aquaticus aquaticus* (Bachman 1837)

Specimen examined (1).—USA: Mississipi; Warren County, Mint Springs, UTM 15-700812N-3583804E, 1 (VICK 5318).

Eastern Chipmunk, *Tamias striatus pipilans* Lowery 1943

Specimen examined (1).—USA: Mississippi; Warren County, Glass Bayou, UTM 15-703001N-3582711E, 1 (VICK 5327). *Additional records* (4).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703143N-3581960E, 2; Boy Scout Trail at Grant Ave. and Union Ave. intersection, UTM 15-703311N-3583971E, 1; Service Rd. between Maintenance Area and Visitor Center, UTM 15-702377N-3580682E, 1.

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Eastern Fox Squirrel, *Sciurus niger subauratus* Linnaeus 1758

Specimen examined (1).—USA: Mississippi; Warren County, Service Road between Maintenance Area and Visitor Center, UTM 15-702377N-3580682E, 1 (VICK 5276). *Additional records* (14).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703143N-3581960E, 2; Mint Springs, UTM 15-700722N-3583781E, 1; Boy Scout Trail Sherman Circle, UTM 15-703260N-3584309E, 1; Mint Springs, UTM 15-700812N-3583804E, 1; Turtle Pond, UTM 15-700861N-3584486E, 1; Trail behind Restoration Shop, UTM 15-700803N-3584376E, 1; Sherman Circle, UTM 15-703428N-3584300E, 3; 400 m N Main Entrance, UTM 15-702322N-3580537E, 1; E Graveyard Rd., UTM 15-702956N-3583720E, 1; Intersection of Visitor Center and South Loop, UTM 15-702054N-3580559E, 1; 50 m N Shirley House, UTM 15-703296N-3582497E, 1.

Southern Flying Squirrel, *Glaucomys volans saturatus* Howell 1915

Specimen examined (1).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703099N-3581913E, 1 (VICK 5305). *Additional records* (4).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703099N-3581913E, 3; South Loop between bridges 1 and 3, UTM 15-701633N-3579679E, 1.

American Beaver, *Castor canadensis carolinensis* Kuhl 1820

Specimen examined (1).—USA: Mississippi; Warren County, Mint Springs, UTM 15-700400N-3583701E, 1 (VICK 5343). *Additional record* (1).—USA: Mississippi; Warren County, UTM 15-700400N-3583701E, 1.

Eastern Harvest Mouse, *Reithrodontomys humulis humulis* (Audubon and Bachman 1841)

Specimen examined (1).—USA: Mississippi; Warren County, E Graveyard Rd., UTM 15-703053N-3583674E, 1 (VICK 5270).

Cotton Deer Mouse, *Peromyscus gossypinus gossypinus* (LeConte 1853)

Specimens examined (10).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703099N-3581913E, 2 (VICK 5295, VICK 5297); Boy Scout Trail between Tour Stops 4 and 5, UTM 15-703141N-3583414E, 2 (VICK 5300, VICK 5301); Between Tour Stops 4 and 5, UTM 15-703387N-3583143E, 1 (VICK 5311); Mint Springs, UTM 15-700644N-3583757E, 1 (VICK 5321); Yazoo River Watershed, UTM 15-700153N-3583624E, 5 (VICK 5330,VICK 5331,VICK 5335, VICK 5339, VICK 5340).

White-footed Deer Mouse, *Peromyscus leucopus leucopus* (Rafinesque 1818)

Specimens examined (7).—USA: Mississippi; Warren County, Boy Scout Area, UTM 15-702631N-3584423E, 1 (VICK 5273); NE Union Ave. and Jackson Rd., UTM 15-703377N-3582360E, 1 (VICK 5275); Union Ave. 200 m N Pemberton Ave., UTM 15-703099N-3581913E, 3 (VICK 5296, VICK 5298, VICK 5299); Mint Springs, UTM 15-700644N-358757E, 2 (VICK 5322, VICK 5323).

Hispid Cotton Rat, *Sigmodon hispidus hispidus* Say and Ord 1825

Specimens examined (7).—USA: Mississippi; Warren County, Fort Hill, UTM 15-700343N-3583311E, 3 (VICK 5306, VICK 5308, VICK 5309); 200 m N Pemberton Ave. and Union intersection, UTM 15-702888N-3581915E, 2 (VICK 5310, VICK 5312); Old Hwy. 27 100 m S Park Entrance, UTM 15-702307N-3580356E, 2 (VICK 5324, VICK 5326). *Additional records* (2).—USA: Mississippi; Warren County, 200 m N Pemberton Ave. and Union intersection, UTM 15-702888N-3581915E, 1; Fort Garrett, UTM-15-700343N-3583311E, 1.

APPENDIX (CONT.)

Eastern Woodrat, *Neotoma floridana rubida* (Bangs 1898)

Specimen examined (1).—USA: Mississippi, Warren County, Mississippi Monument, UTM 15-702302N-3581527E, 1 (VICK 5303). *Additional records* (2).—USA: Mississippi, Warren County, Union Ave. 400 m W Grant Ave, UTM 15-701365N-3584339E, 1; Mint Springs, UTM 15-700644N-3583757E, 1.

Woodland Vole, *Microtus pinetorum auricularis* Bailey 1898

Specimens examined (3).—USA: Mississippi; Warren County, Boy Scout Area, UTM 15-702339N-3584380E, 3 (VICK 5285, VICK 5286, VICK 5287).

House Mouse, *Mus musculus brevirostris (Waterhouse 1837)**

Specimens examined (7).—USA: Mississippi; Warren County, E Mississippi Monument, UTM 15-702302N-3581527E, 1 (VICK 5284); Yazoo River Watershed, UTM 15-700153N-3583624E, 1 (VICK 5329); Yazoo River Watershed, UTM 15-700197N-3583750E, 5 (VICK 5336, VICK 5337, VICK 5338, VICK 5341, VICK 5342). *Additional record* (1).—USA: Mississippi; Warren County, Yazoo River Watershed, UTM 15-702888N-3581915E, 1.

Domestic Dog, *Canis lupus familiaris* Linnaeus 1758

Specimen examined (1).—USA: Mississippi; Warren County, Mint Springs, UTM 15-700812N-3583804E, 1 (VICK 5319). *Additional records* (48).—Mississippi; Warren County, South Loop culvert, UTM 15-701723N-3579927E, 1; Bridge crossing NE weather station, UTM 15-702407N-3584492E, 2; Boy Scout Trail S Louisiana Monument, UTM 15-702661N-3581514E, 3; Mint Springs, UTM 15-700812N-3583804E, 25; Boy Scout Trail at Sherman Circle, UTM 15-701363N-3584368E, 2; Boy Scout Area, UTM 15-702635N-3584467E, 3; Turtle Pond, UTM 15-700861N-3584486E, 9; Boy Scout Trail S Louisiana Monument, UTM 15-702600N-3581239E, 1; Boy Scout Trail S Louisiana Monument, UTM 15-702556N-3581377E, 2.

Red Fox, *Vulpes vulpes fulva* (Desmarest 1820)

Specimen examined (1).—USA: Mississippi; Warren County, Connecting Ave. Bridge, UTM 15-700646N-3583759E, 1 (VICK 5288). *Additional records* (11).—USA: Mississippi; Warren County, National Cemetery, UTM 15-700675N-3583783E, 4; Bridge crossing NE weather station, UTM 15-702407N-3584492E, 1; Sherman Circle, UTM 15-703428N-3584300E, 5; Connecting Ave. Bridge, UTM 15-700646N-3583759E, 1.

Gray Fox, *Urocyon cinereoargenteus floridanus* (Rhoads 1895)

Specimen examined (1).—USA: Mississippi; Warren County, Intersection of Union Ave. and Boy Scout Area entrance, UTM 15-702157N-3584008, 1 (VICK 5316). *Additional records* (19).—USA: Mississippi; Warren County, Connecting Ave. Bridge, UTM 15-700619N-3583819E, 1; Mint Springs, UTM 15-700898N-3583874E, 1; National Cemetery, UTM 15-700439N-3583852E, 3; Connecting Ave. Bridge, UTM 15-700646N-3583759E, 6; Turtle Pond, UTM 15-700861N-3584486E, 7; Boy Scout Trail from Confederate Ave. to Cairo Museum, UTM 15-701673N-3583702E, 1.

Raccoon, *Procyon lotor varius* (Nelson and Goldman 1930)

Specimen examined (1).—USA: Mississippi; Warren County, 200 m N Pemberton Ave., UTM 15-703115N-3581924E, 1 (VICK 5272). *Additional records* (70).—USA: Mississippi; Warren County, Mint Springs, UTM 15-700722N-3583781E, 2; South Loop Culvert, UTM 15-701723N-3579927E, 5; Boy Scout Trail S Louisiana Monument, UTM 15-702661N-3581514E, 2; Mint Springs, UTM 15-700812N-3583804E, 1; Boy Scout Trail between Mile Posts 4 and 5,

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UTM 15-700898N-3583874E, 4; Glass Bayou culvert off Modern Jackson Rd., UTM 15-703126N-3582694E, 2; Turtle Pond, UTM 15-700861N-3584486E, 8; Boy Scout Trail S Louisiana Monument, UTM 15-702753N-3581938E, 1; Old Superintendent's Quarters, UTM 15-702753N-3581938E, 1; 30 m SW Boy Scout Meeting Area, UTM 15-702535N-3584199E, 4; Boy Scout Trail S Louisiana Monument, UTM 15-702600N-3581239E, 1; Glass Bayou at Modern Jackson Rd., UTM 15-702785N-3582580E, 8; Boy Scout Trail S Louisiana Monument, UTM 15-702556N-3581377E, 7; Boy Scout Area 100 m W weather station, UTM 15-702282N-3584353E, 15; Thayer's Approach, UTM 15-701938N-3583752E, 2; Sherman Circle, UTM 15-703428N-3584300E, 1; Fort Garrett, UTM 15-701281N-3579838E, 1; Boy Scout Meeting Area, UTM 15-702581N-3584413E, 1; SE Boy Scout Meeting Area, UTM 15-702859N-3584371E, 1; South Loop, UTM 15-701612N-3579782E, 1; W Tributary Stout's Bayou, UTM 15-701894N-3580314E, 1; E Tributary Stout's Bayou, UTM 15-702576N-3580881E, 1.

Long-tailed Weasel, *Mustela frenata arthuri* (Hall 1927)

Specimen examined (1).—USA: Mississippi; Warren County, 1st bridge after Main Entrance, UTM 15-702563N-3580726E, 1 (VICK 5344).

Striped Skunk, *Mephitis mephitis nigra* (Peale and Palisot de Beauvois 1796)

Specimen examined (1).—USA: Mississippi; Warren County, Visitor Center, UTM 15-702252N-3580588E, 1 (VICK 5313).

Domestic Cat, *Felis catus* (Schreber 1775)

Specimens examined (2).—USA: Mississippi; Warren County, National Cemetery, UTM 15-700343N-3583952E, 1 (VICK 5334). *Additional record* (1).— USA: Mississippi; Warren County, National Cemetery, UTM 15-700675N-3583783E, 1.

Bobcat, *Lynx rufus floridanus* Rafinesque 1817

Specimen examined (1).—USA: Mississippi; Warren County, Glass Bayou culvert at Modern Jackson Rd., UTM 15-703126N-3582694E, 1 (VICK 5328). *Additional records* (6).—USA: Mississippi; Warren County, Glass Bayou at Modern Jackson Rd., UTM 15-702785N-3582580E, 5; Boy Scout Trail S Louisiana Monument UTM 15-702556N-3581377E, 1.

White-tailed Deer, *Odocoileus virginianus virginianus* (Zimmermann 1780)

Specimen examined (1).—USA: Mississippi; Warren County, Turtle Pond, UTM 15-700861N-3584486E, 1 (VICK 5320). *Additional records* (52).—USA: Mississippi; Warren County, South Loop culvert, UTM-15-701723N-3579927E, 8; Boy Scout Trail at Sherman Circle, UTM 15-701363N-3584368N, 4; Mint Springs, UTM 15-700812N-3584226E, 2; Turtle Pond, UTM 15-700861N-3584486E, 18; Boy Scout Trail N Graveyard Rd., UTM 15-702539N-3583708E, 4; Boy Scout Trail N Graveyard Rd., UTM 15-702795N-3583650E, 7; Trail behind Restoration Shop, UTM 15-700803N-3584376E, 3; Boy Scout Trail from Confederate Ave. to Cairo Museum, UTM 15-701673N-3583702E, 1; Boy Scout Area, UTM 15-702282N-3584353E, 2; Edge of Kudzu Management Area, UTM 15-701339N-3579952E, 1; Boy Scout Trail N Graveyard Rd., UTM 15-702662N-3583717E, 1; South Loop, UTM 15-701281N-3579838E, 1.

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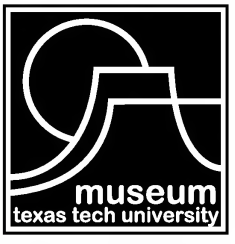

ISSN 0149-175X

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